

Preliminary Amendment

Application No.: 10/820,024

Reply to Office Action dated May 25, 2009 and
Advisory Action dated August 24, 2009

April 16, 2010

REMARKS

By this amendment, claims 3, 16, 33, 34 and 40 have been amended in the application. Currently, claims 3, 5, 7, and 9-41 are pending in the application.

Claims 3, 5, 7 and 9-41 were rejected under 35 USC 103(a) as being obvious over Kawakami et al. (JP 1-242782). Also, claims 3, 5, 7 and 9-41 were rejected under 35 USC 103(a) as being obvious over Kawakami et al. in view of Kaneyoshi (U.S. Patent Application Publication No. 2001-0055685). Also, claims 3, 5, 7 and 9-41 were rejected under 35 USC 103(a) as being obvious over Kawakami et al. or Kawakami et al. in view of Kaneyoshi and further in view of Svendsen et al. (U.S. Patent No. 5,262,718). Further, claims 3, 5, 7 and 9-41 were rejected under 35 USC 103(a) as being obvious over Kawakami et al. or Kawakami et al. in view of Kaneyoshi or over Kawakami et al. in view of Svendsen et al. or Kawakami et al. in view of Kaneyoshi, further in view of Svendsen et al., and further in view of Weber et al. (U.S. Patent No. 6,274,241). Further, claims 3, 5, 7 and 9-41 were rejected under 35 USC 103(a) as being obvious over the cited prior art as applied above and further in view of Segawa et al. (JP 2001-316834).

Preliminary Amendment
Application No.: 10/820,024
Reply to Office Action dated May 25, 2009 and
Advisory Action dated August 24, 2009
April 16, 2010

These rejections are respectfully traversed in view of the enclosed Declaration under 37 CFR 1.132 showing the differences with the prior art to Kawakami et al., the amendments to the claims and the remarks below.

The present invention relates to a conductive electroless plated powder and a method for making the same. More particularly, the present invention relates to a conductive electroless plated powder provided with nickel films having improved heat resistance (see page 1, lines 7-11 of the specification).

In the nickel film of the plated powder of the present invention, many columnar structures extending in the direction of the thickness gather tightly to form a dense, homogeneous, and continuous film as shown in Fig. 1. On the other hand, in the nickel film of the conventional plated powder shown in Fig. 2, the crystal grains are rough and heterogeneous. The present inventors have found that, in the nickel film having the columnar structures as shown in Fig. 1, unexpected results have been found which include that the heat resistance is high and the conductivity of the plated powder is not really decreased even under high temperature conditions (see page 5, lines 9-19 of the specification).

Preliminary Amendment

Application No.: 10/820,024

Reply to Office Action dated May 25, 2009 and

Advisory Action dated August 24, 2009

April 16, 2010

The present invention discloses that the initial thin film formation step is carried out to deposit nickel uniformly on the core particles and to smooth the surfaces of the core particles. In the initial thin film formation step, first, the core particles supporting the noble metal are dispersed in water thoroughly. A shear dispersing machine, such as a colloid mill or homogenizer, may be used for the dispersion. When the core particles are dispersed, for example, a dispersing agent, such as a surfactant, may be used as necessary. The aqueous suspension thus prepared is mixed and dispersed in an initial thin film-solution containing nickel ions, a reducing agent, and a complexing agent composed of an amine. Thereby, the reduction of nickel ions is started, and nickel initial thin films are formed on the surfaces of the core particles. Since the initial thin film formation step is carried out to deposit nickel uniformly on the core particles and to smooth the surfaces of the core particles, the resultant initial thin nickel film only requires a small thickness which enables smoothing the surfaces of the core particles.

The present invention also discloses that it is important to involve a complexing agent in the initial thin film-forming solution. By incorporating the complexing agent in the initial thin film-forming solution and by incorporating the complexing agent in the

Preliminary Amendment

Application No.: 10/820,024

Reply to Office Action dated May 25, 2009 and

Advisory Action dated August 24, 2009

April 16, 2010

nickel ion-containing solution, it is possible to form a nickel film having columnar structures (see page 12, lines 20-26 of the specification).

In the electroless plating step, a first solution, which contains a nickel ion-containing solution and the complexing agent, and a second solution, which contains a reducing agent, are added to the aqueous suspension individually and simultaneously. The aqueous suspension contains the core particles provided with the initial thin nickel films and the complexing agent to perform electroless plating so that columnar structures extending in a direction of a thickness of a nickel film are formed.

By this amendment, independent claims 3 and 33 have been amended to recite "(II) adding a slurry, which includes the core particles prepared by said step of (I), to an initial thin film-forming solution containing nickel ions, a reducing agent, and a complexing agent comprising an amine to prepare an aqueous suspension, dispersing the core particles in the initial thin film-forming solution, and reducing the nickel ions to form a uniform initial thin nickel film on a surface of each of the core particles and smoothing the surface of the core particles; and (III) adding a first solution, which contains a nickel ion-containing solution and the complexing agent, and a second

Preliminary Amendment

Application No.: 10/820,024

Reply to Office Action dated May 25, 2009 and

Advisory Action dated August 24, 2009

April 16, 2010

solution, which contains a reducing agent, to the aqueous suspension individually and simultaneously, the aqueous suspension containing the core particles provided with the initial thin nickel films and the complexing agent to perform electroless plating and forming a homogeneous and continuous nickel film including columnar structures extending in a direction of a thickness of the nickel film on the surface of the core particles".

Similarly, independent claims 16 and 34 have been amended to recite "A method for making a conductive electroless plated powder forming a homogeneous and continuous nickel film including columnar structures extending in a direction of a thickness of the nickel film comprising the steps of: (II) adding a slurry, which includes the core particles prepared by said step of (I), to an initial thin film-forming solution containing nickel ions, a reducing agent, and a complexing agent comprising an amine to prepare an aqueous suspension, dispersing the core particles in the initial thin film-forming solution, and reducing the nickel ions to form a uniform initial thin nickel film on a surface of each of the core particles and smoothing the surface of core particles; (III) adding a first solution, which contains a nickel ion-containing solution and the complexing agent, and a second

Preliminary Amendment

Application No.: 10/820,024

Reply to Office Action dated May 25, 2009 and

Advisory Action dated August 24, 2009

April 16, 2010

solution, which contains a reducing agent, to the aqueous suspension individually and simultaneously, the aqueous suspension containing the core particles provided with the initial thin nickel films and the complexing agent to perform electroless plating".

Similarly, independent claim 40 recites "(II) adding a slurry, which includes the core particles prepared by said step of (I), to an initial thin film-forming solution containing 1) nickel ions, 2) a reducing agent including one of sodium hypophosphite, sodium borohydride, potassium borohydride, dimethylamine borane, hydrazine and formalin, and 3) a complexing agent comprising an amine to prepare an aqueous suspension, dispersing the core particles in the initial thin film-forming solution, and wherein said step of dispersing the core particles in an initial thin film-forming solution containing nickel ions includes adjusting the reducing agent in the initial thin film-forming solution in the range between 4×10^{-4} and 2.0 mol/l so that the nickel ions are reduced to form a uniform initial thin nickel film on a surface of each of the core particles and smoothing the surface of core particles; and (III) adding a first solution, which contains a nickel ion-containing solution and the complexing agent, and a second solution, which contains a

Preliminary Amendment
Application No.: 10/820,024
Reply to Office Action dated May 25, 2009 and
Advisory Action dated August 24, 2009
April 16, 2010

reducing agent, to the aqueous suspension individually and simultaneously, the aqueous suspension containing the core particles provided with the initial thin nickel films and the complexing agent to perform electroless plating and forming a homogeneous and continuous nickel film including columnar structures extending in a direction of a thickness of the nickel film on the surface of core particles". These features are not shown or suggested by Kawakami et al., Kaneyoshi, Svendsen et al., Weber et al. and Segawa et al. or any combination of these references.

Kawakami et al. relate to an electroless plated powder and a production process therefore (see page 1, lines 14-15 of the translation).

Kawakami et al. disclose the step of adding at least two solutions constituting the electroless plating solution individually and simultaneously to the aqueous suspension to perform an electroless plating (see page 18, line 23 - page 19, line 6 of the translation).

Kawakami et al. also disclose the concentration of each agent can be set within the saturation concentration and is not particularly limited. However, since low concentration is not economical, the lower limit is naturally limited from the

Preliminary Amendment
Application No.: 10/820,024
Reply to Office Action dated May 25, 2009 and
Advisory Action dated August 24, 2009
April 16, 2010

practical point of view (see page 20, lines 1-5 of the translation).

Kawakami et al. also disclose that by adding the plating solution, plating reaction starts promptly. If the individual agents are added at the proper ratio all of the metal salt added is reduced and deposited on the surface of the core material. Consequently, the thickness of the plating film can be controlled arbitrarily depending on the amount of addition (page 21, lines 7-12 of the translation).

Kawakami et al. do not disclose the steps of (II) adding a slurry, which includes the core particles prepared by the step of (I), to an initial thin film-forming solution containing nickel ions, a reducing agent, and a complexing agent comprising an amine to prepare an aqueous suspension, dispersing the core particles in the initial thin film-forming solution, and reducing the nickel ions to form a uniform initial thin nickel film on a surface of each of the core particles and smoothing the surface of the core particles; and (III) adding a first solution, which contains a nickel ion-containing solution and the complexing agent, and a second solution, which contains a reducing agent, to the aqueous suspension individually and simultaneously, the aqueous suspension containing the core particles provided with

Preliminary Amendment
Application No.: 10/820,024
Reply to Office Action dated May 25, 2009 and
Advisory Action dated August 24, 2009
April 16, 2010

the initial thin nickel films and the complexing agent to perform electroless plating and forming a homogeneous and continuous nickel film including columnar structures extending in a direction of a thickness of the nickel film on the surface of the core particles as claimed in independent claims 3 and 33.

Kawakami et al. also do not disclose that a method for making a conductive electroless plated powder forming a homogeneous and continuous nickel film including columnar structures extending in a direction of a thickness of the nickel film comprising the steps of: (II) adding a slurry, which includes the core particles prepared by the step of (I), to an initial thin film-forming solution containing nickel ions, a reducing agent, and a complexing agent comprising an amine to prepare an aqueous suspension, dispersing the core particles in the initial thin film-forming solution, and reducing the nickel ions to form a uniform initial thin nickel film on a surface of each of the core particles and smoothing the surface of core particles; (III) adding a first solution, which contains a nickel ion-containing solution and the complexing agent, and a second solution, which contains a reducing agent, to the aqueous suspension individually and simultaneously, the aqueous suspension containing the core particles provided with the

Preliminary Amendment
Application No.: 10/820,024
Reply to Office Action dated May 25, 2009 and
Advisory Action dated August 24, 2009
April 16, 2010

initial thin nickel films and the complexing agent to perform electroless plating as claimed in independent claims 16 and 34.

Kawakami et al. also do not disclose the steps of (II) adding a slurry, which includes the core particles prepared by the step of (I), to an initial thin film-forming solution containing 1) nickel ions, 2) a reducing agent including one of sodium hypophosphite, sodium borohydride, potassium borohydride, dimethylamine borane, hydrazine and formalin, and 3) a complexing agent comprising an amine to prepare an aqueous suspension, dispersing the core particles in the initial thin film-forming solution, and wherein the step of dispersing the core particles in an initial thin film-forming solution containing nickel ions includes adjusting the reducing agent in the initial thin film-forming solution in the range between 4×10^{-4} and 2.0 mol/l so that the nickel ions are reduced to form a uniform initial thin nickel film on a surface of each of the core particles and smoothing the surface of core particles; and (III) adding a first solution, which contains a nickel ion-containing solution and the complexing agent, and a second solution, which contains a reducing agent, to the aqueous suspension individually and simultaneously, the aqueous suspension containing the core particles provided with the initial thin nickel films and the

Preliminary Amendment

Application No.: 10/820,024

Reply to Office Action dated May 25, 2009 and

Advisory Action dated August 24, 2009

April 16, 2010

complexing agent to perform electroless plating and forming a homogeneous and continuous nickel film including columnar structures extending in a direction of a thickness of the nickel film on the surface of core particles as claimed in independent claim 40.

Applicants note that in the office action, the Examiner admitted that Kawakami et al. failed to teach that one more plated nickel layer is applied over the plated nickel layer. However, the Examiner believed that it was a well-known principle to reapply a coating composition to achieve a desired thickness of a final coating depending on the intended use of the final coated product.

Applicants respectfully submit that the Declaration under 1.132 submitted with this amendment proves that even though the method of second step (electroless plating treatment) in Kawakami et al. was repeated after the first step (catalyzing treatment) and the second step (electroless plating treatment) of Kawakami et al. as the Examiner discussed in the office action, columnar structures extending in a direction of the thickness of the nickel film were not observed as shown in Fig. 1 of the SEM picture attached with the declaration.

Preliminary Amendment
Application No.: 10/820,024
Reply to Office Action dated May 25, 2009 and
Advisory Action dated August 24, 2009
April 16, 2010

Fig. 1 of the SEM picture in the declaration shows the upper nickel film layer and the lower nickel film layer. The upper nickel film layer and the lower nickel film layer have different colors as shown in the picture. The lower nickel film layer was produced by the first electroless plating treatment. The upper nickel film layer was produced by the second electroless plating treatment.

As a result of this experiment, columnar structures extending in a direction of the thickness of the nickel film were not observed when the second step of Kawakami et al. was repeated over the first plated nickel film layer.

On the other hand, the method of the present invention has the initial thin film formation step (the claimed step II) for uniformly and smoothly forming an initial thin nickel film, and the electroless plating step (the claimed step III) for performing electroless plating because the present invention intends to make a homogeneous and continuous nickel film including columnar structures extending in a direction of a thickness of the nickel film (not controlling the desired thickness of the final coating as discussed by the Examiner).

In the office action mailed on August 15, 2008, the Examiner stated that in the Declaration under 37 CFR 1.132 filed on July

Preliminary Amendment
Application No.: 10/820,024
Reply to Office Action dated May 25, 2009 and
Advisory Action dated August 24, 2009
April 16, 2010

9, 2008, it was not clear why applicants did not follow the method of Kawakami et al. as described in the working examples and obtained a nickel film when Kawakami et al. taught that a nickel film was formed using a plating solution wherein the mixing ratio of the nickel salt and alkali borohydride should vary from 1:1.5 to 2.5 (see translation, page 19, last paragraph and table 3) (see page 8 of the office action mailed on August 15, 2008).

However, applicants respectfully submit that the Examiner is wrong about this point because applicants exactly followed the method discussed in examples 1 to 10 of Kawakami et al. in Experiment 1 of the Declaration under 37 CFR 1.132 filed on October 26, 2007. In this method, the molar ratio of the solution a (Nickel sulfate) and the solution b (Sodium hypophosphite) is 1:2.5 (see Table 5 on page 25 of translation).

The Examiner choose the plating solution wherein the mixing ratio of the nickel salt and alkali borohydride should vary from 1:1.5 to 2.5. However, this is only one of the examples as shown in Table 3. In the declaration submitted with this amendment, applicants followed the method described in examples 1 to 10 of Kawakami et al. so that a plating solution contains the mixing

Preliminary Amendment
Application No.: 10/820,024
Reply to Office Action dated May 25, 2009 and
Advisory Action dated August 24, 2009
April 16, 2010

ratio of the nickel salt and sodium hypophosphite between 1:2 to 3 as shown in Table 3.

Also, applicants respectfully submit that the second nickel film layer produced by experiment 1 of the declaration was just random pieces of nickel powder that were over the random located first nickel powder particles. In Fig. 2 of the SEM picture in the declaration attached with this amendment, the top view of the nickel film of the electroless nickel plated powder obtained in Experiment 1 shows rough surface of the nickel film.

On the other hand, in Fig. 3 of the SEM picture in the declaration attached with this amendment, the top view of the nickel film of the electroless nickel plated powder obtained in the present invention shows a smooth surface of the nickel film because many columnar structures extending in the direction of the thickness gather tightly to form a dense, homogeneous, and continuous film. In the nickel film having the claimed columnar structures, unexpected results have been found which include that the heat resistance is high and the conductivity of the plated powder is not really decreased even under high temperature conditions.

For these reasons, it is believed that Kawakami et al. do not show or suggest the present claimed features of the present

Preliminary Amendment
Application No.: 10/820,024
Reply to Office Action dated May 25, 2009 and
Advisory Action dated August 24, 2009
April 16, 2010

invention. Applicants also submit that Kaneyoshi, Svendsen et al., Weber et al. and Segawa et al. do not make up for the deficiencies in Kawakami et al.

Since Kaneyoshi, Svendsen et al., Weber et al. and Segawa et al. are the secondary references in the rejections and these references do not show or suggest the presently claimed invention.

Kaneyoshi, Svendsen et al., Weber et al. and Segawa et al. do not disclose the steps of (II) adding a slurry, which includes the core particles prepared by the step of (I), to an initial thin film-forming solution containing nickel ions, a reducing agent, and a complexing agent comprising an amine to prepare an aqueous suspension, dispersing the core particles in the initial thin film-forming solution, and reducing the nickel ions to form a uniform initial thin nickel film on a surface of each of the core particles and smoothing the surface of the core particles; and (III) adding a first solution, which contains a nickel ion-containing solution and the complexing agent, and a second solution, which contains a reducing agent, to the aqueous suspension individually and simultaneously, the aqueous suspension containing the core particles provided with the initial thin nickel films and the complexing agent to perform

Preliminary Amendment
Application No.: 10/820,024
Reply to Office Action dated May 25, 2009 and
Advisory Action dated August 24, 2009
April 16, 2010

electroless plating and forming a homogeneous and continuous nickel film including columnar structures extending in a direction of a thickness of the nickel film on the surface of the core particles as claimed in independent claims 3 and 33.

Kaneyoshi, Svendsen et al., Weber et al. and Segawa et al. also do not disclose that a method for making a conductive electroless plated powder forming a homogeneous and continuous nickel film including columnar structures extending in a direction of a thickness of the nickel film comprising the steps of: (II) adding a slurry, which includes the core particles prepared by the step of (I), to an initial thin film-forming solution containing nickel ions, a reducing agent, and a complexing agent comprising an amine to prepare an aqueous suspension, dispersing the core particles in the initial thin film-forming solution, and reducing the nickel ions to form a uniform initial thin nickel film on a surface of each of the core particles and smoothing the surface of core particles; (III) adding a first solution, which contains a nickel ion-containing solution and the complexing agent, and a second solution, which contains a reducing agent, to the aqueous suspension individually and simultaneously, the aqueous suspension containing the core particles provided with the initial thin nickel films and the

Preliminary Amendment
Application No.: 10/820,024
Reply to Office Action dated May 25, 2009 and
Advisory Action dated August 24, 2009
April 16, 2010

complexing agent to perform electroless plating as claimed in independent claims 16 and 34.

Kaneyoshi, Svendsen et al., Weber et al. and Segawa et al. also do not disclose the steps of (II) adding a slurry, which includes the core particles prepared by the step of (I), to an initial thin film-forming solution containing 1) nickel ions, 2) a reducing agent including one of sodium hypophosphite, sodium borohydride, potassium borohydride, dimethylamine borane, hydrazine and formalin, and 3) a complexing agent comprising an amine to prepare an aqueous suspension, dispersing the core particles in the initial thin film-forming solution, and wherein the step of dispersing the core particles in an initial thin film-forming solution containing nickel ions includes adjusting the reducing agent in the initial thin film-forming solution in the range between 4×10^{-4} and 2.0 mol/l so that the nickel ions are reduced to form a uniform initial thin nickel film on a surface of each of the core particles and smoothing the surface of core particles; and (III) adding a first solution, which contains a nickel ion-containing solution and the complexing agent, and a second solution, which contains a reducing agent, to the aqueous suspension individually and simultaneously, the aqueous suspension containing the core particles provided with

Preliminary Amendment
Application No.: 10/820,024
Reply to Office Action dated May 25, 2009 and
Advisory Action dated August 24, 2009
April 16, 2010

the initial thin nickel films and the complexing agent to perform electroless plating and forming a homogeneous and continuous nickel film including columnar structures extending in a direction of a thickness of the nickel film on the surface of core particles as claimed in independent claim 40.

It is therefore respectfully submitted that Kawakami et al., Kaneyoshi, Svendsen et al., Weber et al. and Segawa et al., individually or in combination, do not teach, disclose or suggest the presently claimed invention and it would not have been obvious to one of ordinary skill in the art to combine these references to render the present claims obvious.

In view of foregoing remarks, it is respectfully submitted that the application is in condition for allowance and an action to this effect is respectfully requested.

Preliminary Amendment
Application No.: 10/820,024
Reply to Office Action dated May 25, 2009 and
Advisory Action dated August 24, 2009
April 16, 2010

If there are any questions or concerns regarding these remarks, the Examiner is requested to telephone the undersigned at the telephone number listed below.

Respectfully submitted,


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